MONASH University
Engineering

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# Towards "zero" false positives in structural health monitoring

# Report Documentation Page

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**Structural Health Monitoring is one aspect of a revolution based on the use of Smart Materials and Structures technologies that have the potential to provide major gains in structural performance and cost-efficient life management. We seek to address the issue of information fidelity from ISHM systems (i.e. minimal or no "false positives") expressed by representatives from Airbus, Boeing, EADS, US FAA, Lockheed Martin, NASA and USAF at the Panel Discussion at the 5th IWSHM. This work will contribute to the first steps towards the transitioning of current state-of-the-art innovations in SHM to their widespread acceptance in the aerospace industry. This initial work is a concerted study that provides the sound scientific and engineering arguments towards the confidence in information fidelity will constitute a significant leap in the knowledge base of ISHM. The work proposed in this document respond to this challenge and will be the first concerted study towards the provision of these sound scientific and engineering arguments towards the widespread acceptance of ISHM.**

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# Research Team

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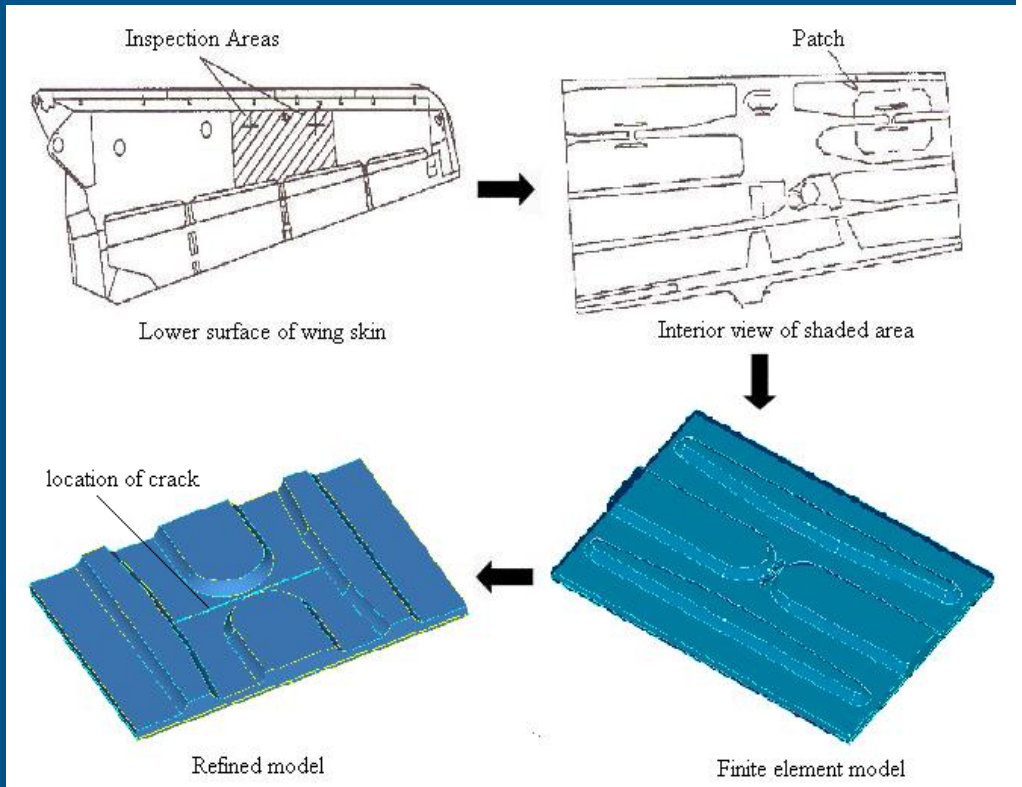
# Technical Objectives

- **Aim (1): Characterize the scattering of stress waves by defects or service-induced damage in representative aircraft structures with multi-layered construction and geometry variation. This knowledge shall be used in the development of a robust structural health monitoring scheme.**

- **Aim (2): Develop and validate robust approaches for determining and enhancing the "inspectability" of non-surface penetrating defects in such structures with the objective of eliminating "false positives".**

# Rationale for work

- Discovery of crack on the lower wing skin of F111 aircraft[1]
- Structure repaired with bonded composite patch
- Can in-situ structural health monitoring be used to monitor crack[2]?
- What are the effects of geometry variation on the propagating stress wave?




**Wong, Chiu, Rajic & Galea (2006)Can stress waves be used for monitoring sub-surface defects in repaired structures? Composite Structures (in press)**

[1]Baker, Rose, Walker Wilson (1999) Repair substantiation for a bonded composite repair to F111 lower wing skin, Applied Composite Materials, Vol 6, no 4, pp 251-267

2 Wong,Chiu, Rajic & Galea (2006) Can stress waves be used for monitoring sub-surface defects in repaired structures, Composite Structures (in press)

# Findings to date

- **Use of finite element analysis to investigate the effects of geometry changes on the ability monitor crack growth under a bonded repair patch**

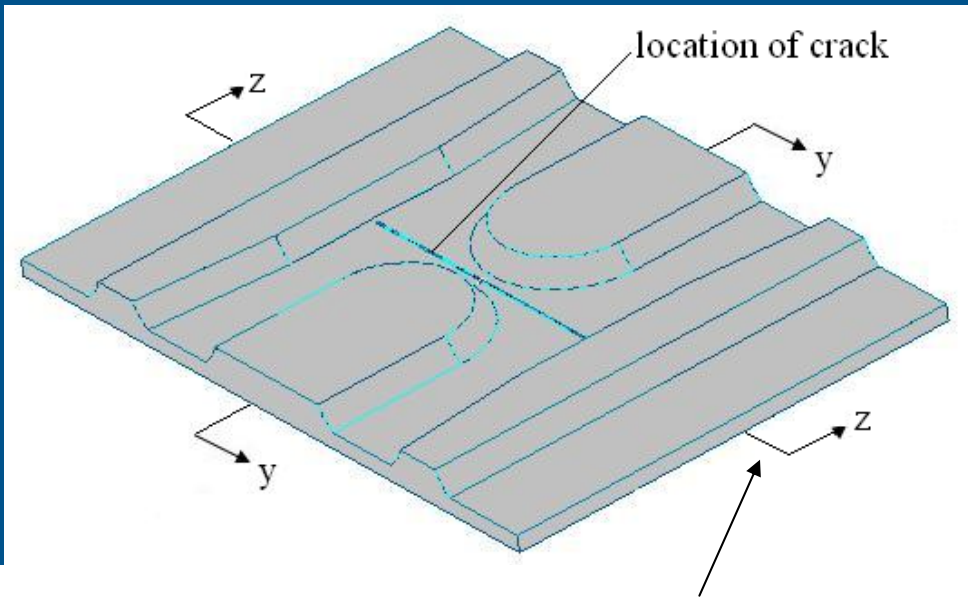
- **NEi/Nastran + FEMap used. Analysis method validated for the study of propagation of stress wave[1]**

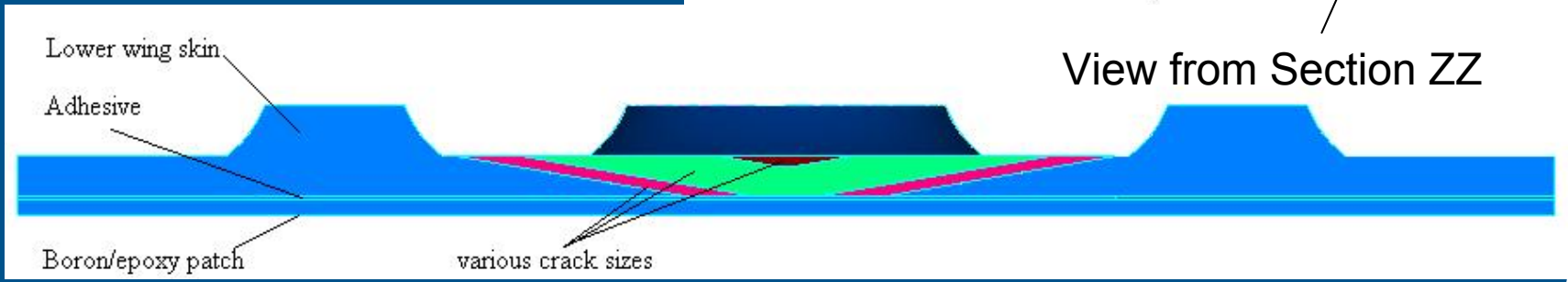
[1] Koh, Y.L., Chiu, W.K., Rajic, N. (2002) Integrity assessment of composite repair patch using propagating Lamb Waves, Composite Structures, Vol 58, No. 2, pp 305-306.

# Findings to date

Finite element model of F111 lower wing skin

Crack configurations considered

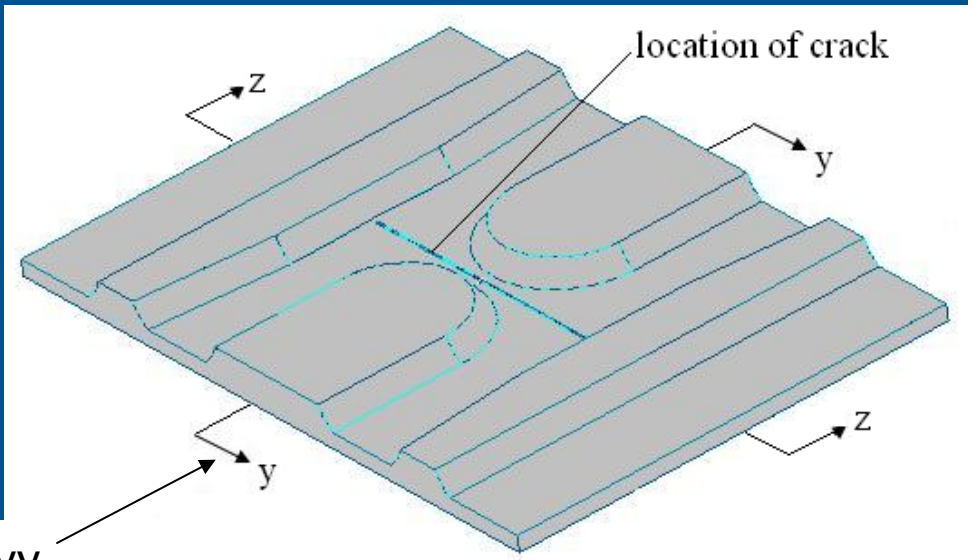


# Findings to date

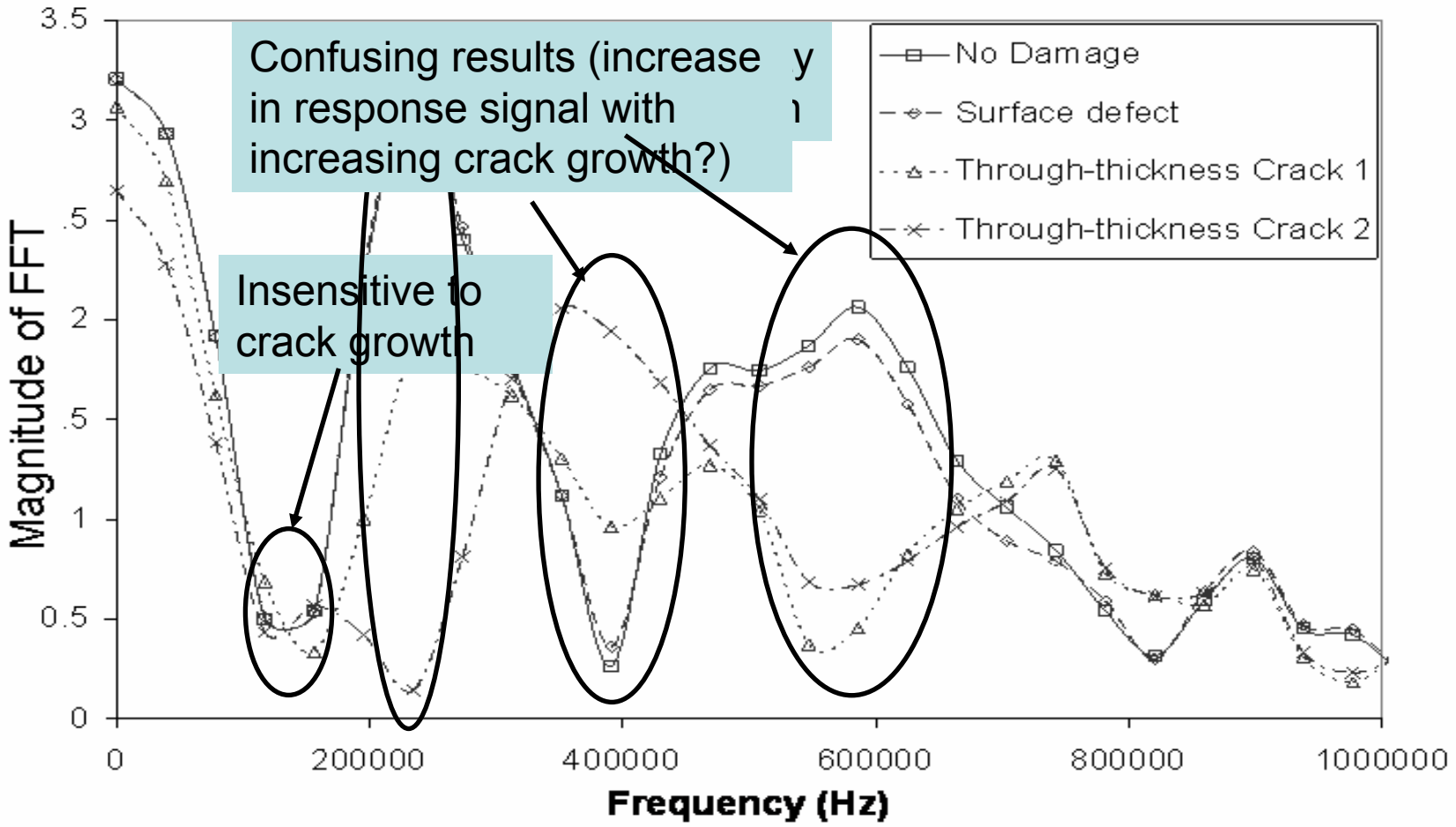
Finite element model of F111 lower wing skin

Location of actuator and sensors used in analysis




View from Section yy

# Findings to date



# Findings to date

- **Finite element analysis of the effects of geometry variation on the propagating stress wave**
- **Results show that the ability to determine the presence of crack is frequency dependent (Why?)**

# Future plans

- **Current research proposal seek to develop an understanding on the above to develop a criteria for the usage of stress wave based SHM methodology**
- **What are the implications of wave scattering of stress waves resulting from geometry variation on SHM?**

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**Abstract**
Structural Health Monitoring is one aspect of a revolution based on the use of Smart Materials and Structures technologies that have the potential to provide major gains in structural performance and cost-efficient life management. We seek to address the issue of information fidelity from ISHM systems (i.e. minimal or no "false positives") expressed by representatives from Airbus, Boeing, EADS, US FAA, Lockheed Martin, NASA and USAF at the Panel Discussion at the 5th IWSHM. This work will contribute to the first steps towards the transitioning of current state-of-the-art innovations in SHM to their widespread acceptance in the aerospace industry. This initial work is a concerted study that provides the sound scientific and engineering arguments towards the confidence in information fidelity will constitute a significant leap in the knowledge base of ISHM. The work proposed in this document respond to this challenge and will be the first concerted study towards the provision of these sound scientific and engineering arguments towards the widespread acceptance of ISHM.